# DKM-260

DESCRIPTION

The DKM-260 is a precision instrument designed for monitoring the status of earth leakage in a DC supply busbar. It also measures, displays and remote monitors various DC parameters of a DC distribution box.

The unit features a 32-bit ARM core microcontroller.

The unit is supplied from the busbar voltage. It accepts from 19 to 150VDC busbar voltage.

The current input of the unit is isolated from the rest of the circuit and has different circuit options:

- External current shunt (standard)
- Internal current shunt
- Hall Effect sensor input

The relay output is programmable for its function.

Thanks to its isolated RS-485 Modbus RTU comport, the device is free from ground potential difference issues and data are safely transferred to automation and monitoring systems. Program parameters may be uploaded to the unit through the RS-485 port.

FEATURES

- *Indicates ground leakage in %*
- *DC analyzer functionality*
- *Programmable relay output*
- *Various current input options*
- *Demand records*
- *Fully isolated RS-485 serial port*
- *MODBUS-RTU communications*
- *Front panel programming*
- *Wide operating temperature range*
- *Sealed front panel (IP65 with gasket)*
- *Two part connection system*

> ### SAFETY NOTICE
> ### Failure to follow below instructions will result in death or serious injury

- Electrical equipment should be installed only by qualified specialist. No responsibility is assured by the manufacturer or any of its subsidiaries for any consequences resulting from the non-compliance to these instructions.
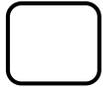
- Check the unit for cracks and damages due to transportation. Do not install damaged equipment.

- Do not open the unit. There are no serviceable parts inside.
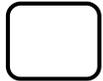
- Fuses must be connected to the power supply and voltage inputs, in close proximity of the unit.

- Fuses must be of fast type with a maximum rating of 6A.

- Disconnect all power before working on equipment.

- When the unit is connected to the network do not touch terminals.

- Any electrical parameter applied to the device must be in the range specified in the user manual. Although the unit is designed with a wide safety margin, over-range parameters may reduce lifetime, alter operational precision or even damage the unit.

- Do not try to clean the device with solvent or the like. Only clean with a dump cloth.

- Verify correct terminal connections before applying power.

- Only for front panel mounting.

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INSTALLATION INSTRUCTIONS

Before installation:

- Read the user manual carefully, determine the correct connection diagram.

- Remove all connectors and mounting brackets from the unit, then pass the unit through the mounting opening.

- Put mounting brackets and tighten. Do not tighten too much, this can damage the enclosure.

- Make electrical connections with plugs removed from sockets, then place plugs to their sockets.

- Be sure that adequate cooling is provided.

- Be sure that the temperature of the environment will not exceed the maximum operating temperature in any case.

- Be sure that the unit is not subject to water spill.

Below conditions may damage the device:

- Incorrect connections.

- Incorrect power supply voltage.

- Voltage at measuring terminals beyond specified range.

- Current at measuring terminals beyond specified range.

- Voltage applied to digital inputs over specified range.

- Connecting or removing data terminals when the unit is powered-up.

- High voltage applied to communication ports.

- Excessive vibration, direct installation on vibrating parts.


> ⚠️ **Current Shunt _must_ be used for current measurement.**
> **No direct connection allowed.**

Below conditions may cause abnormal operation:

- Power supply voltage below minimum acceptable level.

1.1 FRONT AND BACK PANELS
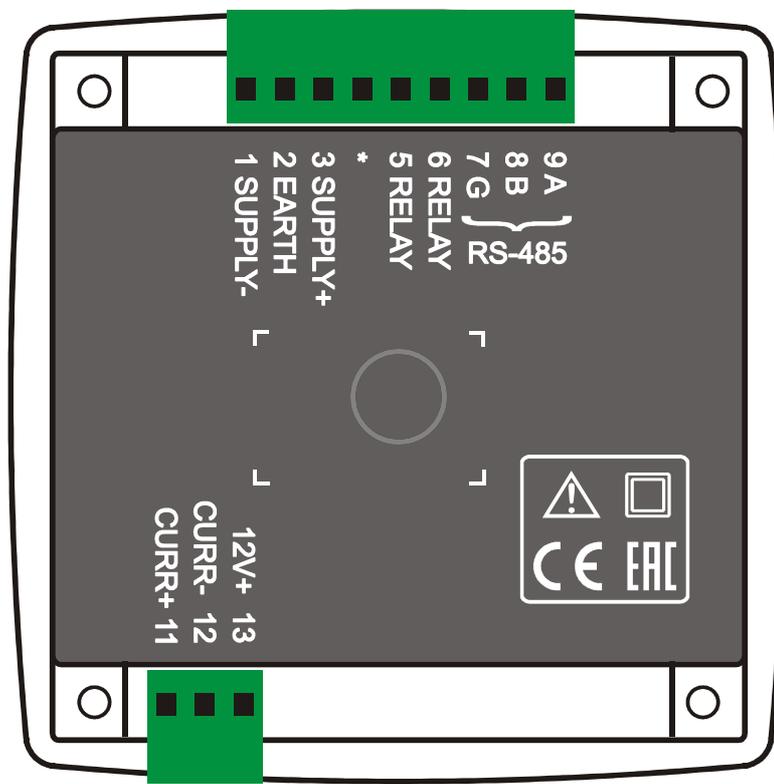
1.2 ELECTRICAL INSTALLATION

Do not install the unit close to high electromagnetic noise emitting devices like contactors, high current busbars, switchmode power supplies and the like.

Although the unit is protected against electromagnetic disturbance, excessive disturbance can affect the operation, measurement precision and data communication quality.

- **ALWAYS remove plug connectors when inserting wires with a screwdriver.**

- **Fuses must be connected to the power supply and voltage inputs, in close proximity of the unit.**

- **Fuses must be of fast type with a maximum rating of 6A.**

- **Use cables of appropriate temperature range.**

- **Use adequate cable section, at least 0.75mm^2 (AWG18).**

- **Follow national rules for electrical installation.**

Current Shunt <u>must</u> be used for current measurement.
No direct connection allowed.

1.3 INSTALLATION DIAGRAM
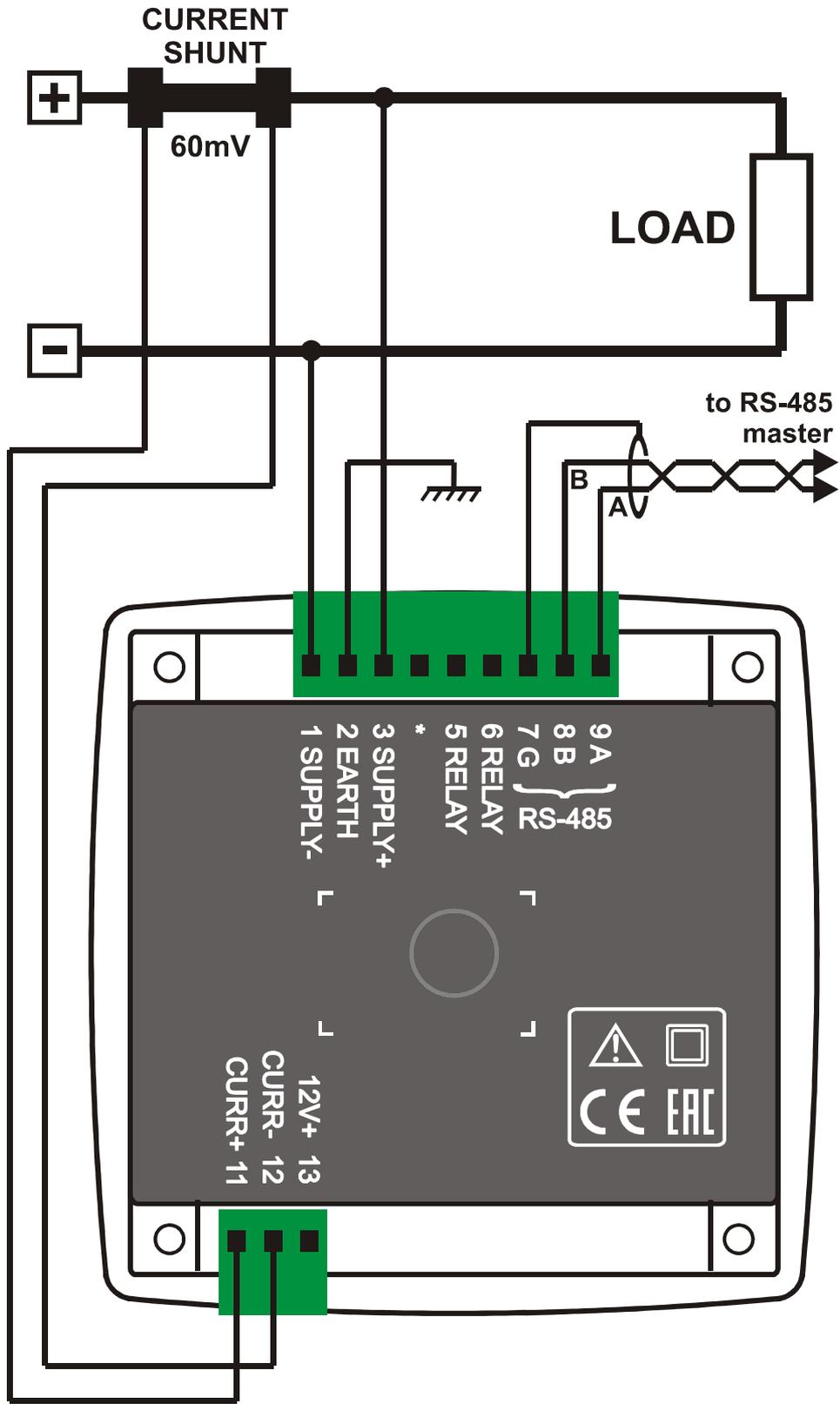
2. PUSHBUTTON FUNCTIONS

Programlama ve ölçüm ekranlarına ön paneldeki 3 adet buton sayesinde ulaşılır.

BUTTON	FUNCTION
SET	**PROGRAMMING: Save adjusted parameter and exit adjusting mode.** **Enter adjusting mode.**
MENU ↑	**Switch to the upper screen.** **PROGRAMMING: increase value**
MENU ↓	**Switch to the lower screen.** **PROGRAMMING: decrease value**
MENU ↓ MENU ↑	**HELD PRESSED TOGETHER FOR 2 SECONDS:** **Selects programming mode. If held pressed in programming mode, then returns to normal mode.**
	NO KEY PRESSED DURING 1 MINUTE: **Returns to the selected main display screen.**

3. SCREEN NAVIGATION
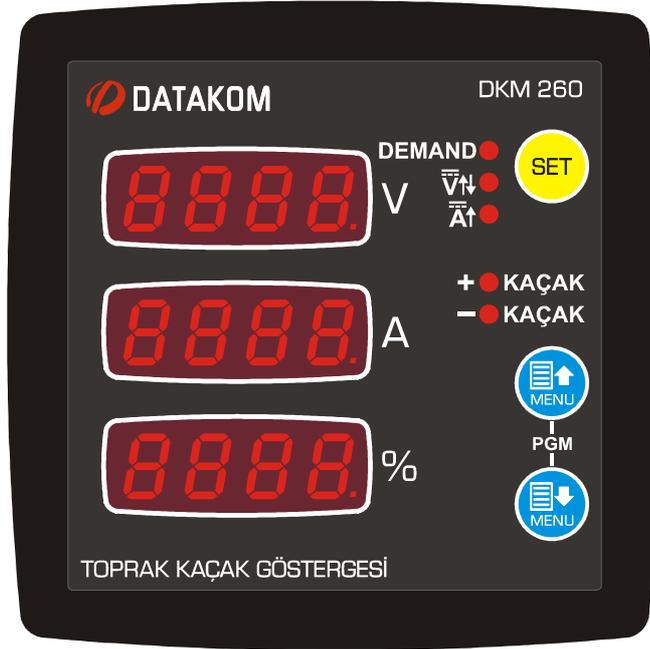
 Buttons allow navigation between measurement values.

The first screen displays voltage in volts (V), second screen displays current in amperes (A) and the third screen displays earth leakage in percantage (%) unit. If no led is on then it means that these are instantaneous measured values. However, if DEMAND led is on these values are demand values.

Display of measured current: If the measured current value is below 100A, then it is displayed with 0.01A precision. Between 100A and 1000A it is displayed with 0.1A precision. Between 1000A and 10000A it is displayed with 1A precision.

Display of measured voltage: If the measured voltage value is below 100V then it is displayed with 0.01V precision. If the voltage is between 100V and 1000V it is displayed with 0.1V precision. Between 1000V and 10000V the voltage is displayed with 1 V precision.

Alarm display: Alarms are displayed by leds on front panel. When a high or low voltage alarm occurs, led "V" turns on. When an overcurrent alarm occurs, led "A" turns on. When a positive earth leakage alarm occurs, led "+KAÇAK" turns on and when a negative earth leakage alarm occurs, led "-KAÇAK" turns on.

4. PROGRAMMING

4.1 ENTERING THE PROGRAMMING MODE

In order to offer the maximum flexibility to the customer, the module has several programmable parameters.

- ➢ **Measurement configurations**
  - ▪ Demand reset
  - ▪ Alarm reset
- ➢ **Current shunt configuration**
- ➢ **Alarm high/low limit adjustments**
- ➢ **Input/Output Configurations**
  - ▪ Alarm configuration
  - ▪ Modbus configuration
- ➢ **Unit Calibration**

	In order to enable the programming menu, hold both MENU buttons pressed for 2 seconds.
	In order to exit programming menu, hold both MENU buttons pressed for 2 seconds. **If no button is pressed during 1 minute, then the unit will automatically close the programming mode.**
	Parameter values are modified with UP and DOWN Menu buttons. If the button is held pressed, the the value will change with larger steps.
	When SET button is pressed, the value on the screen is recorded and the unit exits the adjusting mode.
	Held pressed for 5 seconds on display screen to clear all alarms.
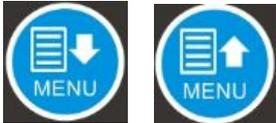
4.2 RESETTING DEMANDS
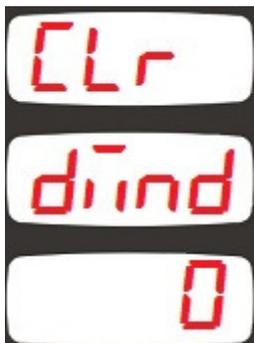
Parameter value
0: No operation
1: Reset demand counters

Setting this parameter to 1 causes demand and max_demand values to be reset.

The parameter value is not saved and always reads 0.

4.3 RESETTING ALARM
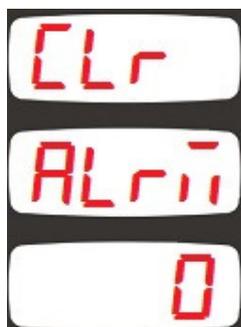
Parameter value
0: No operation
1: Reset alarms

Setting this parameter to 1 causes alarms to be reset.

The parameter value is not saved and always reads 0.

4.4 ADJUSTING CURRENT MEASUREMENT INPUT

This parameter adjusts the rated value of the current shunt in amperes.

The factory set value is 40A

Adjustement range is between 1 and 3200amperes
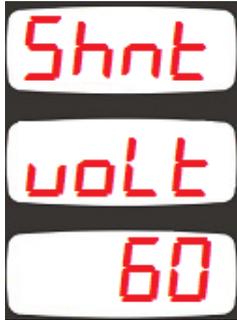
This parameter adjusts the rated voltage of the current shunt in milivolts.

The factory set value is 60mV

Adjustement range is between 1 and 100milivolts.

4.5 ALT VE ÜST TOPRAK KAÇAK LİMİTLERİNİN AYARLANMASI

Bu parametre toprak kaçak için toprak geriliminin giriş gerilimine oranının üst limitini ayarlar.

Standart fabrika çıkış değeri 70% 'dir.

Ayar aralığı 0 V ile 100 arasıdır.

Bu parametre toprak kaçak için toprak geriliminin giriş gerilimine oranının alt limitini ayarlar.

Standart fabrika çıkış değeri 30 % 'dir.

Ayar aralığı 0 ile 100 arasıdır.

4.6 ADJUSTING VOLTAGE LOW AND HIGH LIMITS

This parameter adjusts the upper limit of the high voltage alarm.

If this parameter is set to 300 then high voltage is not monitored and no alarm occurs.

Factory set value is 300V

Adjustment range is between 0 and 300V

This parameter adjusts the lower limit of the low voltage alarm.

If this parameter is set to 0 then low voltage is not monitored and no alarm occurs.

Factory set value is 0 V

Adjustment range is between 0 and 300V

4.7 ADJUSTING CURRENT HIGH LIMIT

This parameter adjusts the overcurrent limit.

If this parameter is adjusted to 2000 then the overcurrent limit is not monitored and the overcurrent alarm does not occur.

 Factory set value is 2000 A

Adjustment range is between 0 A and 2000 A

4.8 ADJUSTING THE DEMAND PERIOD

This parameter determines the demand period for voltage, current and power measurements. The average value is calculated during the demand period and at the end of the period new demand values overwrite older values.

Factory set value is 15 minutes.

Adjustment range is 1 to 240 minutes.

4.9 SELECTING RELAY FUNCTION

This parameter determines the relay function which dedicates using relay in which alarm(s) .

Factory set value is 8.

According to parameter value, Alarms, which use relay, are as below:

0: Earth Leakage (+)

1: Earth Leakage (-)

2: High Voltage

3: Low Voltage

4: Overcurrent

5: Earth Leakage (+) or Earth Leakage (-)

6: High or Low Voltage

7: High or Low Voltage or Overcurrent

8: All alarm cases

Adjustment range is 0 to 8.

4.10 ALARM CONFIGURATION

**ERrh
RLtii
10**

This parameter determines the delay between an earth leakage alarm condition occurs and the alarm given.

Factory set value is 10.

Adjustment range is 0 to 255 seconds.

**ERrh
LoCt
0**
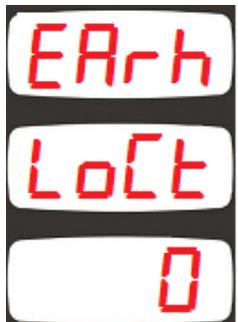
0: Earth leakage alarm lock disabled

1: Earth leakage alarm lock enabled

When this parameter is set to 1, even if the alarm cause is removed, alarms will persist until manually reset.

When this parameter is set to 0, when the alarm cause is removed, alarms automatically disappear.

Factory set value is 0.

Adjustment range is 0 to 1.

**uoLt
RLtii
5**

This parameter determines the delay between a high or low valtage alarm condition occurs and the alarm given.

Factory set value is 5.

Adjustment range is 0 to 255 seconds.

**uoLt
LoCt
0**
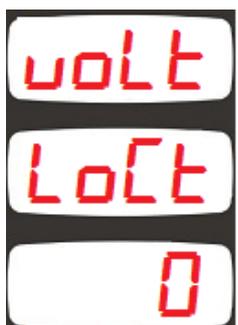
0: High or low voltage alarm lock disabled

1: High or low voltage alarm lock enabled

When this parameter is set to 1, even if the alarm cause is removed, alarms will persist until manually reset.

When this parameter is set to 0, when the alarm cause is removed, alarms automatically disappear.

Factory set value is 0.

Adjustment range is 0 to 1.

```
[Urr
ALtii
    3
```

This parameter determines the delay between a high current alarm condition occurs and the alarm given.

Factory set value is 3.

Adjustment range is 0 to 255 seconds.

```
[Urr
LoCt
    0
```

0: High current alarm lock disabled

1: High current alarm lock enabled

When this parameter is set to 1, even if the alarm cause is removed, alarms will persist until manually reset.

When this parameter is set to 0, when the alarm cause is removed, alarms automatically disappear.

Factory set value is 0.

Adjustment range is 0 to 1.

4.11 MODBUS PARAMETERS
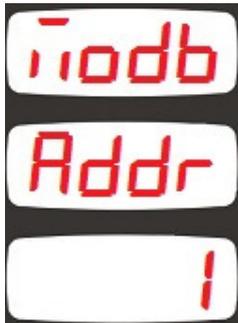
This parameter determines the Modbus node address of the unit. Every unit in the same Modbus loop must have a different node address.

Factory set value is 1.

Adjustment range is 0 to 245.

This parameter determines the data rate (baud rate) used in the Modbus communication. Every unit in the same Modbus loop must use the same data rate.

0: Baud rate = 2400

1: Baud rate = 4800

2: Baud rate = 9600

3: Baud rate = 19200

4: Baud rate = 38400

 Factory set value is 2.

Adjustment range is 0 to 4.
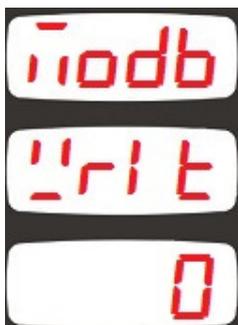
If this parameter is set to a value different from 0, then the unit will require this parameter as a password prior to Modbus writes or Modbus commands.

If the parameter is set to 0 then no password is required.

Factory set value is 0.

Adjustment range is 0 to 9999.

4.12 DISPLAYING THE FIRMWARE VERSION
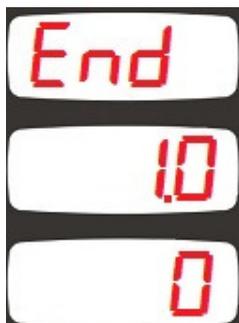
The firmware version is displayed in te second line of the "*End* , End" screen.

Any inquiry to the manufacturer must state the firmware version in question.

4.13 CALIBRATION

The unit leaves the production in a calibrated status.

If recalibration is required, enter the password "3282" to the third line of the "*End* , End" screen and press the SET button.
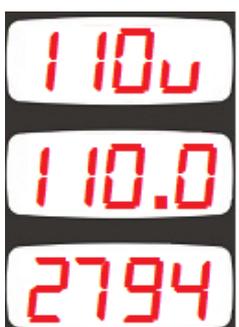
The calibration screen about the 110V voltage input will be seen. The first display will show "110V". The second screen will display the measured instantaneous voltage from the input. The third display will display the calibration coefficient (high 4 digits only)

Adjust UP and DOWN menu buttons until the value displayed in the second screen is correct.

When the value is correct then press SET button. The unit will switch to first current input sensitivity calibration.

In the first current input sensitivity calibration mode, the first display will show "1CUR". The second screen will display the measured instantaneous current from the input. The third display will display the calibration coefficient (high 4 digits only)

Adjust UP and DOWN menu buttons until the value displayed in the second screen is correct.

When the value is correct then press SET button. The unit will switch to second current input sensitivity calibration.

The second current input is internal and makes a more precise measurement in low currents. The switching between two internal inputs is automatic. Between -10mV and +10mV the sensitive input is used. Above this signal amplitude the normal input is active.

In the second current input sensitivity calibration mode, the first display will show "2CUR". The second screen will display the measured instantaneous current from the input. The third display will display the calibration coefficient (high 4 digits only)

Adjust UP and DOWN menu buttons until the value displayed in the second screen is correct.

When the value is correct then press SET button. The unit will switch to earth leakage input calibration.

In earth leakage input calibration mode, the first display will show "EARH". The second screen will display the measured instantaneous voltage from the input. The third display will display the calibration coefficient (high 4 digits only)

Adjust UP and DOWN menu buttons until the value displayed in the second screen is correct.

When the value is correct then press SET button. The unit will switch to 110v input calibration.

4.14 LAMP TEST
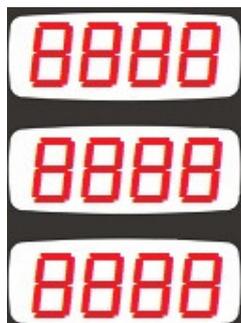
When programming is over, hold pressed UP and DOWN MENU buttons for 2 seconds.

The unit will exit program mode and will turn on all lights for lamp testing purpose.

Check that all lights are on.

Press any button to resume normal operation.

5. MODBUS COMMUNICATIONS

5.1. DESCRIPTION

The unit offers serial data communication port allowing it to be integrated in automation systems.

The serial port is of RS-485 MODBUS-RTU standard. It is fully isolated from power supply and measurement terminals for failure-free operation under harsh industrial conditions.

The MODBUS properties of the unit are:
    -Data transfer mode: RTU
    -Serial data: 2400-38400 bps, 8 bit data, no parity, 1 bit stop
    -Supported functions:
        -Function 3 (Read multiple registers)
        -Function 6 (Write single register)
        -Function 10 (Write multiple register)
    -The answer to an incoming message is sent with a minimum of 4.3ms delay after message reception.

Each register consists of 2 bytes (16 bits). Larger data structure contain multiple registers.

Detailed description about the MODBUS protocol is found in the document "**Modicon Modbus Protocol Reference Guide**". This document may be downloaded at:
http://www.modbus.org/specs.php

Data Reading

The function 03 (read multiple registers) will be used for data reading. The MODBUS master will send a query. The answer will be one of the below:
    -A response containing the requested data
    -An exceptional response indicating a read error.

The maximum number of registers read in one message is 120. If more registers are requested, the unit will send only the first 120 registers.

The query message specifies the starting register and quantity of registers to be read. The message structure is below:

Byte	Description	Value
0	Controller address	1 to 254
1	Function code	3
2	Starting address high	See below the description of available
3	Starting address low	registers
4	Number of registers high	always 0
5	Number of registers low	max 78h (120 decimal)
6	CRC low byte	See below for the checksum calculation
7	CRC high byte	

Here is the sequence to read 16 registers starting from address 20h (32 decimal):
01 03 00 20 00 10 45 CC (each byte is expressed as 2 hexadecimal characters)

The checksum value in the above message may be used for the verification of checksum calculation algorithm.

The normal response will be:

Byte	Description	Value
0	Controller address	same as in the query
1	Function code	3
2	Data lenght in **bytes** (L)	number of registers * 2
3	High byte of 1st register	
4	Low byte of 1st register	
5	High byte of 2nd register	
6	Low byte of 2nd register	
....		
L+1	High byte of the last register	
L+2	Low byte of the last register	
L+3	CRC low byte	See below for the checksum calculation
L+4	CRC high byte	

The exceptional response will be:

Byte	Description	Value
0	Controller address	same as in the query
1	Function code	131 (function code + 128)
2	Exception code	2 (illegal address)
3	CRC low byte	See below for the checksum calculation
4	CRC high byte	

Data Writing

The function 06 (write single register) or function 10h (write multiple registers) is used for data writing. A maximum of 32 registers can be written at a time.

The MODBUS master will send a query containing data to be written. The answer will be one of the below:
   -A normal response confirming successful write,
   -An exceptional response indicating a write error.

Only some of the available registers are authorized to be written. An attempt to write a write protected register will result to the exceptional response.

The query message specifies the register address and data. The message structure is below:

Byte	Description	Value
0	Controller address	1 to 254
1	Function code	6
2	Register address high	See below the description of available registers
3	Register address low	
4	Data high byte	
5	Data low byte	
6	CRC low byte	See below for the checksum calculation
7	CRC high byte	

Here is the sequence to write the value 0010h to the register 40h (64 decimal):
01 06 00 40 00 10 89 D2 (each byte is expressed as 2 hexadecimal characters)

The checksum value in the above message may be used for the verification of checksum calculation algorithm

The normal response will be the same as the query:

Byte	Description	Value
0	Controller address	1 to 254
1	Function code	6
2	Register address high	See below the description of available registers
3	Register address low	
4	Data high byte	
5	Data low byte	
6	CRC low byte	See below for the checksum calculation
7	CRC high byte	

The exceptional response will be:

Byte	Description	Value
0	Controller address	same as in the query
1	Function code	134 (function code + 128)
2	Exception code	2 (illegal address) or 10 (write protection)
3	CRC low byte	See below for the checksum calculation
4	CRC high byte	

CRC calculation

Here is a procedure for generating a CRC:

1) Load a 16–bit register with FFFF hex (all 1's). Call this the CRC register.

2) Exclusive OR the first 8–bit byte of the message (the function code byte) with the low–order byte of the 16–bit CRC register, putting the result in the CRC register.

3) Shift the CRC register one bit to the right (toward the LSB), zero–filling the MSB. Extract and examine the LSB. The LSB is the least significant bit of the CRC **before** the shift operation.

4) If the LSB is 1: Exclusive OR the CRC register with the polynomial value A001 hex.

5) Repeat Steps 3 and 4 until 8 shifts have been performed. Thus, a complete 8–bit byte will be processed.

6) Repeat Steps 2 through 5 for the next 8–bit byte of the message. Continue doing this until all bytes have been processed.

7) The final contents of the CRC register is the CRC value.

8) Place the CRC into the message such that the low byte is transmitted first. The algorithm should give the correct CRC for below messages:

       01 03 00 20 00 10 45 CC
       01 06 00 40 00 10 89 D2

Error codes

Only 3 error codes are used:
01: illegal function code
02: illegal address
10: write protection (attempt to write a read_only register)

Data types

Each register consists of 16 bits (2 bytes)

If the data type is a byte, only the low byte will contain valid data. High byte is don't care.

For data type longer than 16 bits, consecutive registers are used. The least significant register comes first.

5.2. COMMANDS

Commands to the unit are written to below addresses.

If the Modbus Write Password parameter is left 0 as in the factory settings, then the unit will not ask any password for Modbus commands and Modbus writes.

If the Modbus Write Password parameter is set to a value other than 0, then the unit will require a password for commands and data writes.

If the value recorded as Modbus Write Password parameter or 3271 is written to the address 7168, then during next 10 minutes, Modbus area can be written and below commands can be executed. All commands (other than the password) may be activated by writing a value other than zero to the related register.

ADRESS	NAME	DESCRIPTION	LENGTH	R/W	DATA TYPE	COEFF
7168	Password	Programming password	16 BIT	W-O	unsigned word	1
7169	Reset demand	Reset all demand registers	16 BIT	W-O	unsigned word	1
7170	Reset alarm	Reset all alarms	16 BIT	W-O	unsigned word	1
7171	Factory set	Return to factory settings	16 BIT	W-O	unsigned word	1

5.3. PROGRAM PARAMETERS

Program parameters of the unit may be read from below registers or program parameters may be set by writing to these registers.

ADRESS	NAME	DESCRIPTION	DIMENS	R/W	DATA TYPE	COEFF
01	Shunt max current	Explained ch 4.4	16 BIT	R/W	unsigned word	1
02	Shunt max voltage	Explained ch 4.4	16 BIT	R/W	unsigned word	1
03	Earth leakage high limit(%)	Explained ch 4.5	16-BIT	R/W	unsigned word	1
04	Earth leakage low limit(%)	Explained ch 4.5	16-BIT	R/W	unsigned word	1
05	Earth leakege alarm lock	Explained ch 4.10	1-BIT	R/W	unsigned word	1
06	Earth leakage alarm delay	Explained ch 4.10	16-BIT	R/W	unsigned word	1
07	Voltage high limit	Explained ch 4.6	16 BIT	R/W	unsigned word	1
08	Voltage low limit	Explained ch 4.6	16 BIT	R/W	unsigned word	1
09	Voltage alarm lock	Explained ch 4.10	1 BIT	R/W	unsigned word	1
10	Voltage alarm delay	Explained ch 4.10	16 BIT	R/W	unsigned word	1
11	Overcurrent limit	Explained ch 4.7	16 BIT	R/W	unsigned word	1
12	Overcurrent alarm lock	Explained ch 4.10	1 bıt	R/W	unsigned word	1
13	Overcurrent alarm delay	Explained ch 4.10	16 bıt	R/W	unsigned word	1
14	Demand periode	Explained ch 4.8	16 BIT	R/W	unsigned word	1
15	Relay function	Explained ch 4.9	16 BIT	R/W	Unsigned word	1
16	Modbus baudrate	Explained ch 4.11	16 BIT	R/W	unsigned word	1
17	Modbus node address	Explained ch 4.11	16 BIT	R/W	unsigned word	1
18	Modbus password	Explained ch 4.11	16 BIT	R/W	unsigned word	1

5.4. MEASUREMENTS AND CONTROLLER RECORDS

ADRESS	NAME	DESCRIPTION	DIMENS	R/W	DATA TYPE	COEFF
8192	Voltage measured from SUPPLY input (V)		32 BIT	R-O	unsigned long	0.01
8194	Current (A)		32 BIT	R-O	unsigned long	0.01
8196	Earth Leakage Voltage (V)		16 BIT	R-O	unsigned word	0.01
8197	Earth Leakage and Input Voltage Ratio (%)		16 BIT	R-O	unsigned word	1
8198	Voltage Demand (V)		32 BIT	R-O	unsigned long	0.01
8200	Current Demand (A)		32 BIT	R-O	unsigned long	0.01
8202	Alarms	Lower 5 bits indicate alarms. Other bits are "don't care".	16 BIT	R-O	unsigned word	1
8203	Unit model		16 BIT	R-O	unsigned word	1
8204	Unit firmware version		16 BIT	R-O	unsigned word	1

Alarm status record is 16 bit long. Each bit indicates the existence of one alarm.

BIT NO:	DESCRIPTION
0	+ Earth Leakage (Alarm 0)
1	- Earth Leakage (Alarm 1)
2	High voltage (Alarm 2)
3	Low voltage (Alarm 3)
4	Overcurrent (Alarm 4)
5	
6	
7	-
8	-
9	-
10	-
11	-
12	-
13	-
14	-
15	-

6. TECHNICAL SPECIFICATIONS

Supply Voltage: 19-150VDC

Power Consumption: < 4W

Voltage Measurements:

    Measurement range: 0-150V

    Measurement Sensitivity: 0.1V

Current Measurement Input:

    Measurement range: 0-100mV.

    Accuracy: % 0.2

Internal Current Shunt Option:

    Measurement range: 0-15A

Relay Output: 16A, volt free contacts

Serial Port:

    Signal type: RS-485

    Protocol: Modbus RTU

    Data Rate: 2400-38400baud

    Isolation: 1000V AC, 1 minute

Operating Temp. Range: -20°C...+70 °C

                 (-4°F...158°F)

Max. Relative Humidity: %95 non-condensing

Protection Degree: IP 65 (Front panel, w. gasket)

                 IP 30 (Back panel)

Enclosure: Flame retardent, ROHS compliant high temperature ABS/PC (UL94-V0)

Installation: Flush mounting with rear brackets **Dimensions:** 102x102x53mm (WxHxD)

Panel Cutout: 92x92mm

Weight: 200 gr

EU Directives: **Reference**
2014/35/EC (LVD) **Standards:**
2014/30/EC (EMC) EN 61010 (safety)
                 EN 61326 (EMC)

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